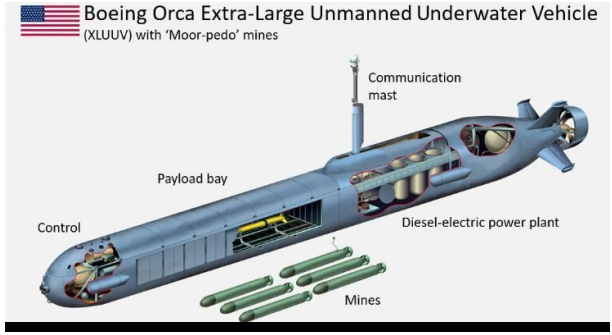
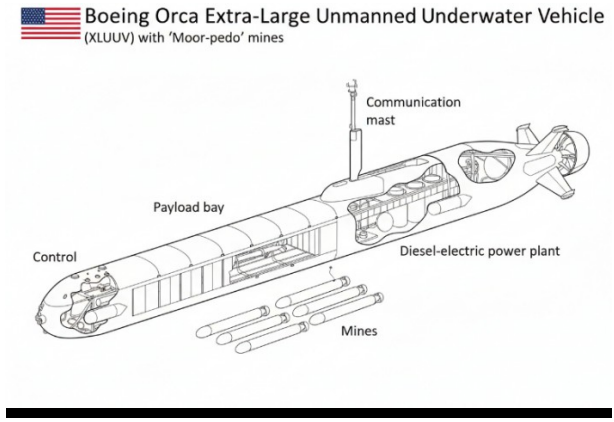
Boeing Defense / HII — Orca XLUUV





IDENTITY & DESIGNATION

Official Designation: Orca Extra-Large Unmanned Undersea Vehicle (XLUUV)

Manufacturer: Boeing Defense (prime contractor) in partnership with Huntington Ingalls Industries (HII)

Country of Origin: United States

Programme Origin: US Navy XLUUV competition — design contracts awarded September 2017 to Boeing/HII and Lockheed Martin

Production Contract: $274.4 million — February 2019 — five prototype vehicles

Basis of Design: Boeing Echo Voyager autonomous UUV demonstrator (introduced 2016)

Operator: US Navy — Unmanned Undersea Vehicle Squadron 3 (UUVRON-3)

NATO/Allied Designation: None — US programme only

Programme Status: Prototype phase — GAO June 2025 report warns programme may not transition to program of record

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CLASSIFICATION

Domain: Subsurface

Category: Military — Extra-Large Autonomous Undersea Vehicle (XLUUV)

Sub-Category: Long-range autonomous submarine — multi-mission modular payload

Terminal Mode: Recoverable — designed to transit, execute mission, and return to pier-side

Expendable: No — $55M+ per unit; pier-side launch and recovery without dedicated support vessel

DoD Classification: Extra-Large UUV (XLUUV) — largest class of autonomous undersea vehicle in US inventory

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PHYSICAL SPECIFICATIONS

Length (base hull): 51 ft (15.5 m)

Length (with payload module): 85 ft (26 m)

Diameter: >84 inches (>2.1 m)

Displacement: ~80–85 tons

Payload Module: 34 ft (10.4 m) modular section — removable for mission tailoring

Payload Capacity: Up to 8 tons (16,000 lb) — internal volume for diverse mission systems

Construction: Modular open architecture — designed for future technology insertion and payload upgrades

Logistics: Pier-side launch and recovery — no dedicated support vessel required

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PROPULSION & PERFORMANCE

Propulsion: Hybrid diesel-electric — lithium-ion batteries for submerged silent running; marine diesel generators for surface recharging

Maximum Speed: ~8 knots

Optimal Cruise Speed: 2.5–3 knots — optimised for range and endurance

Range: 6,500 nautical miles (12,038 km)

Endurance: Months-long autonomous operations

Maximum Depth: Up to 11,000 ft (3,353 m) reported — operational depth classified

Operational Modes: Open-ocean transit; bottom following; long-duration seabed mooring

> **⚠ Battery endurance identified by GAO as a critical technology challenge with ongoing technical difficulties as of 2025.**

GUIDANCE, NAVIGATION & CONTROL

Navigation System: Kalman-filtered Inertial Navigation Unit (INU); Doppler Velocity Logs (DVL); depth sensors; seafloor long baseline (LBL) transponders

Autonomy: Advanced autonomous navigation in clear and congested waters without physical human contact — complex mission execution

Surface Communications: Encrypted Inmarsat IV; Iridium satellite; Wi-Fi; FreeWave — via extendable mast

Subsurface Communications: Acoustic modems — mission re-planning and status reporting while submerged

GPS: Available at or near surface via extendable mast — not available submerged

Software Architecture: Proprietary — GAO flagged that payload changes require paying Boeing to modify proprietary software

> **⚠ Autonomy identified by GAO as a critical technology challenge — ongoing technical difficulties as of 2025.**
>
> **⚠ Proprietary software architecture limits open payload integration — customers pay contractor for any software modifications.**

MISSIONS & PAYLOADS

Primary Missions: Mine countermeasures (MCM); ISR; anti-surface warfare (ASuW); anti-submarine warfare (ASW); electronic warfare (EW); strike; seabed warfare; expeditionary support

Payload Flexibility: 34-ft modular bay supports diverse mission systems — sonar arrays, weapons systems, UAV launchers, smaller UUV deployment

Strike Potential: Navy considers torpedoes, cruise missiles, and UAV launchers as potential payloads — not confirmed in current configuration

ISR Payload: Raytheon PROSAS sonar system confirmed for ocean mapping missions

Nesting Concept: Navy considering Orca as carrier for smaller autonomous vehicles — UUVs, USVs, UAVs deployed from payload bay

[VERIFY] Weapons payload configuration — not publicly confirmed; Navy states it is 'open and considering' torpedo and missile payloads

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COUNTERMEASURE VULNERABILITY PROFILE

RF Jamming: NOT APPLICABLE while submerged — surface mast communications vulnerable when deployed at periscope depth

GPS Denial: LOW–MODERATE — Kalman-filtered INS/DVL provides accurate autonomous navigation; GPS not required for extended submerged periods

Acoustic Detection: MODERATE–HIGH — at 80+ tons, detectable by modern passive sonar; diesel-electric is quieter than nuclear but detectable during snorkeling/recharging cycles

ASW Prosecution: MODERATE–HIGH — full spectrum ASW assets apply: maritime patrol aircraft with sonobuoys, ASW helicopters, attack submarines, surface combatants with towed arrays; large enough to be targeted by Mk 48 class torpedoes

Kinetic Intercept: MODERATE — heavyweight torpedoes, depth charges, and anti-submarine missiles are viable countermeasures

Cyber / Electronic: MODERATE — complex autonomous systems create potential cyber attack surface; extended autonomous operations without oversight increase vulnerability

EMI / EMC: LOW while submerged — military-grade construction with hardening

Proprietary Software Risk: MODERATE — closed architecture limits rapid field modification; payload changes require contractor involvement

Overall Rating: MODERATE — primary vulnerability is acoustic detection during diesel snorkeling cycles; electromagnetically silent at depth

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CRUISE MISSILE CONVERGENCE NOTES

The Boeing Orca is, for all practical purposes, an unmanned cruise missile submarine. It is the logical endpoint of cruise missile convergence in the subsurface domain. The parallels are direct and deliberate:

Range: at 6,500 nautical miles, Orca can transit from CONUS to any theatre on Earth — identical to a Tomahawk-armed submarine's deployment envelope, without the crew.

Modular payload: the 34-foot payload module with standardised interfaces mirrors the Mk 41 VLS or torpedo tube approach to cruise missile carriage. The Navy explicitly envisions arming Orca with torpedoes and cruise missiles.

Autonomous navigation: INS/DVL navigation with months-long autonomous operation parallels Tomahawk's INS/TERCOM/GPS guidance sustained over far longer operational periods.

Cost exchange: at ~$55M per unit versus ~$3B for a Virginia-class submarine, the ratio is approximately 54:1. For the same budget as one Virginia, the Navy

can field 54 Orcas — a force multiplication that changes how undersea presence is calculated.

Nesting: the XLUUV-to-smaller-UUV nesting concept — Orca launching smaller autonomous vehicles from its payload bay — mirrors cruise missile carrier aircraft deploying standoff weapons. The mother platform extends the reach of the daughter payload.

> *ENGINEER'S NOTE: The Orca represents the complete merger of three previously separate concepts: the submarine, the cruise missile platform, and the autonomous weapons system. It navigates like a submarine, carries weapons like a surface combatant, and operates like a cruise missile — pre-programmed mission, no crew required. When I was working on Tomahawk programmes, the submarine was the irreducible minimum — you needed a hull, a crew, a reactor. Orca removes two of those three requirements. What remains is the hull, and even that is now optimised for the mission rather than the crew.*

OPERATIONAL HISTORY & PROGRAMME TIMELINE

2017: Navy awards design contracts (~$40M each) to Boeing/HII and Lockheed Martin for XLUUV competition

2019: Boeing/HII awarded $274.4M production contract for five prototype vehicles — original delivery target: end of 2022

April 2022: Orca christened and undergoes first in-water test

July 2023: First autonomous in-water testing commenced

December 2023: XLE-0 (test asset — no payload section) delivered to US Navy after acceptance tests — approximately one year behind schedule

March 2024: Risk-reduction testing off Southern California coast commenced

Mid-2025: XLE-1 (first operational prototype) sea trials — developmental and operational testing through Q3 FY2025

June 2025: GAO Annual Weapons Assessment warns: 'It is now unclear whether the Navy will transition the XLUUV to a program of record because there are no clear requirements that the XLUUV can meet within current budget constraints' — $885M spent to date

Early 2026: XLE-2 christened by Boeing — second Orca commissioned

Planned: Five total prototypes; Navy intends procurement of 9+ vehicles pending programme of record decision

> ⚠ **Programme has experienced multiple-year delays from original 2022 delivery schedule. GAO identified critical technology challenges in autonomy, battery endurance, and navigation as of 2025. Programme of record transition uncertain.**

> *⚠ PETER NOTE: The Orca programme is a cautionary tale sitting alongside a genuine capability. $885 million over eight years to deliver two test vehicles is exactly the procurement pathology that Replicator-model programmes like Anduril's Dive-LD were designed to bypass. The Dive-LD went from contract to delivery in months. The Orca took years longer than planned and still faces programme of record uncertainty. The capability argument for an 80-ton, 6,500-nautical-mile autonomous submarine is sound. The acquisition model that built it is the problem. These are two*

> *different issues and they should not be conflated — but they cannot be separated from an honest assessment of the platform.*

MANUFACTURING PHILOSOPHY

The Orca was designed as a modular open-architecture platform — the 34-foot payload module is physically removable and theoretically reconfigurable for different mission types. Boeing's stated intent was to create a platform that could accommodate evolving payloads and technology insertions without requiring hull redesign.

In practice, the proprietary software architecture has created integration friction. The GAO specifically flagged that payload changes require Boeing to modify proprietary software — a significant departure from the open systems philosophy and a direct contrast to platforms like the Lumberjack (Palantir open systems) and Dive-LD (Lattice OS platform-agnostic architecture).

The HII partnership brings submarine manufacturing expertise — Huntington Ingalls builds Virginia-class and Columbia-class submarines and brings that supply chain and workforce to the programme. The Boeing-HII teaming mirrors the Northrop-ESAero-Palantir model on the Lumberjack: a large prime integrator working with specialised partners.

SOURCES & CROSS-REFERENCES

Manufacturer:
https://www.boeing.com/defense/autonomous-and-unmanned-systems/xluuv

GAO Warning (June 2025): https://breakingdefense.com/2025/06/after-885-million-gao-warns-its-unclear-if-navys-major-uuv-program-will-become-program-of-record/

Naval Technology: https://www.naval-technology.com/projects/orca-xluuv/

TWZ Interview (Jan 2025): https://www.twz.com/news-features/what-the-navys-massive-orca-submarine-drone-is-actually-capable-of

XLE-2 Christening (Naval News 2026): https://www.navalnews.com/naval-news/2026/03/boeing-christens-second-extra-large-orca-submarine-drone/

Cross-Reference: See Volume 2: Anduril Dive-LD (comparable autonomous UUV, Replicator programme — contrast acquisition model); Anduril Dive-XL / Ghost Shark (XLUUV class, Australian programme); HII REMUS 300 Lionfish (smaller UUV family, same operator ecosystem)

Volume 1 Cross-Reference: Chapter 5.3 (Maritime ISR — subsurface domain); Chapter 4 (Convergence Thesis — submarine/cruise missile merger); Chapter 25 (Lessons Learned — procurement pathology, single-source dependency)

Contrast Note: Read alongside Anduril Dive-LD card — same mission class, radically different acquisition model and timeline. The contrast is analytically instructive.